GE
Intelligent Platforms

GFK-2737D

PAC*Systems RX3i
PROFINET Scanner
Manual

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Revised: May 2014
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Document Updates

Location	Description
The chapter, *Configuration*	The section, *Configuring Module Parameters*, added Universal Analog Input Module and Power Sync and Measurement Module and their rules to the table, the section, *RX3i PROFINET Scanner Configuration Validation*, added IC695ALG600 to the table.

Related Documents

Doc #	Title
GFK-2222	PACSystems CPU Reference Manual
GFK-2308	PACSystems Hot Standby CPU Redundancy User Manual
GFK-2314	PACSystems RX3i System Manual
GFK-2441	PACSystems RX3i High-speed Counter Modules User Manual
GFK-2571	PACSystems RX3i PROFINET Controller Manual
GFK-2572	PACSystems RX3i PROFINET Controller Command Line Interface Manual
GFK-2737	PACSystems RX3i PROFINET Scanner Manual
GFK-2749	PACSystems RX3i Power Sync and Measurement System Manual
GFK-2816	PACSystems RXi ICRXICTL000 Distributed I/O Controller User's Manual
GFK-2904	PROFINET I/O Devices Secure Deployment Guide

Safety Symbol Legend

Warning

Indicates a procedure, condition, or statement that, if not strictly observed, could result in personal injury or death.

Caution

Indicates a procedure, condition, or statement that, if not strictly observed, could result in damage to or destruction of equipment.

Attention

Indicates a procedure, condition, or statement that should be strictly followed to improve these applications.

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1 Introduction

This chapter provides an overview of the PACSystems RX3i PROFINET Scanner (PNS) module and its operation.

Chapter 2, LED Operation and Connector Details, provides detailed description of the module's indicators and ports

Chapter 3, Installation, gives instructions for PNS module installation and replacing a PNS module. Provides information for selecting SFP modules and network cabling and connectors.

Chapter 4, Configuration, describes how to configure the RX3i PROFINET Scanner and its associated IO devices.

Chapter 5, Operations, describes powering up and restarting the RX3i PROFINET Scanner, the input status data, replacing I/O modules while scanning, and how to update the firmware.

Chapter 6, Diagnostics, describes configuration faults, how to check the RX3i PROFINET Scanner version information, fatal error handling, and some common troubleshooting suggestions.

Appendix A, PROFINET Specifications, summarizes the features specified for PROFINET v2.3 Class A I/O Devices that are supported by the RX3i PROFINET Scanner module.

1.1 RX3i PROFINET Scanner Overview

The PACSystems RX3i PROFINET Scanner (PNS) module, IC695PNS001, connects a remote universal RX3i I/O rack of Series 90-30 or RX3i modules to a PROFINET I/O Controller. The PROFINET Scanner scans the modules in its rack, retrieving input data and providing output data, and exchanges that data on the PROFINET I/O LAN at the configured production rate.

The PNS manages PROFINET communication and module configuration between an I/O Controller and modules in the remote rack. If network communications are lost, the PNS manages I/O states according to the individual module configurations.

The PNS supports 10/100/1000 Mbps Copper, 100/1000 Mbps Multi-mode Fiber, and 100/1000 Mbps Single-mode Fiber. PROFINET communications on the network require 100 or 1000 Mbps link speed. Although 10 Mbps cannot be used for PROFINET communications, 10 Mbps can be used for other types of Ethernet traffic such as PING.

Features of the RX3i PNS include:

- Full programming and configuration services for all supported Series 90-30 and RX3i I/O Modules using Proficy* Machine Edition. For a list of currently supported I/O modules, refer to the Important Product Information (IPI) document provided with the firmware version on your PNS module.
- Support for daisy-chain/line, star, or ring (redundant media) topologies.
- Four switched Ethernet ports - two 8-conductor RJ-45 shielded twisted pair 10/100/1000 Mbps copper interfaces and two Small Form-factor Pluggable (SFP) cages for user-supplied SFP devices.
- The network can include media interfaces of more than one type.
- Support for transfer of I/O Device Name to another PNS module using an SD card. This eliminates the need to connect a configuration tool, such as Proficy Machine Edition when replacing a module.
- A USB port for field updates of firmware using WinLoader.

Note The USB port is for firmware upgrades only. It is not intended for permanent connection.

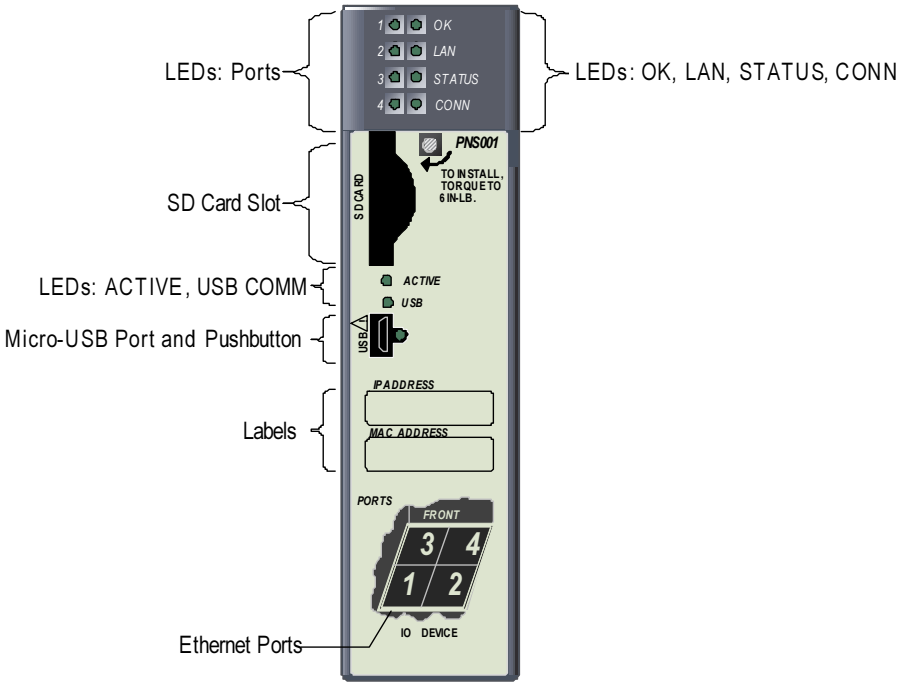
1.2 RX3i PROFINET Scanner Specifications

PROFINET Support	PROFINET Version 2.3 Class A IO-Device Redundantly controlled operation conforms to PROFINET V2.3 Type S-2 System Redundancy.	
Controller CPU Version Required	RX3i CPU315/CPU320 with firmware version 7.10 or later RX3i CPE305/CPE310 with firmware version 7.10 or later RXi Controller with firmware version 7.80 or later	
Proficy Machine Edition Version Required	Version 8.0 or later	
Power Requirements	3.3 V:	1.2 A with no SFP devices installed 1.9 A maximum (two SFP devices installed, 0.35 A per SFP)
	5 V:	1.1 A maximum
Operating Temperature Range	0 to 60°C Derated to 57°C: • If 100 Mb Fiber SFPs installed, or • If Copper SFPs operating at 1 Gb	
Number of Port Connectors	Two RJ-45 and Two SFP Cages (SFP devices not included, available separately.)	
USB Connector (for firmware upgrades)	One Micro-B connector. USB 2.0 compliant running at Full-speed (12 MHz)	
SD Card	Supports SD and SDHC cards.	
PNS Status and Control Bits	32 input status bits and 32 output control bits	
PROFINET I/O production rate (I/O Update Rate)	Configurable selections: 1 ms, 2 ms, 4 ms, 8 ms, 16 ms, 32 ms, 64 ms, 128 ms, 256 ms or 512 ms	
Number of IP addresses	Five. One per external port and one internal.	
I/O Station Maximum Limits	**Number of I/O Modules per station**	Number of backplane slots minus one for PNS and at least one for a power supply
	I/O data per station	2880 bytes total 1440 bytes of input data 1440 bytes of output data
Configuration	V2.3 GSDML file is included with Proficy Machine Edition; available for import into 3rd-Party tools. **Note:** Configuration software that supports GSDML V2.3 MenuList elements (such as Proficy Machine Edition 8.0 or later) is required to display the configuration parameters of most IC695xxx I/O modules.	

For product standards, general operating specifications, and installation requirements, refer to the PACSystems RX3i System Manual, GFK-2314.

1.3 RX3i PROFINET Scanner Controls and Indicators

The illustration below shows the front of an RX3i PROFINET Scanner.



1.3.1 LEDs on the PROFINET Scanner Module

LEDs provide an immediate visual indication of the PNS's operational state and port link status. The LEDs and their operation are described in Chapter 2 *LED Operation and Connector Details*.

1.3.2 SD Card Slot

The SD Card Slot supports an SD or SDHC card. It can be used to transfer the I/O Device Name to another PROFINET Scanner Module unit without a configuration tool such as Proficy Machine Edition.

1.3.3 Pushbutton

The pushbutton adjacent to the USB port is reserved for future use.

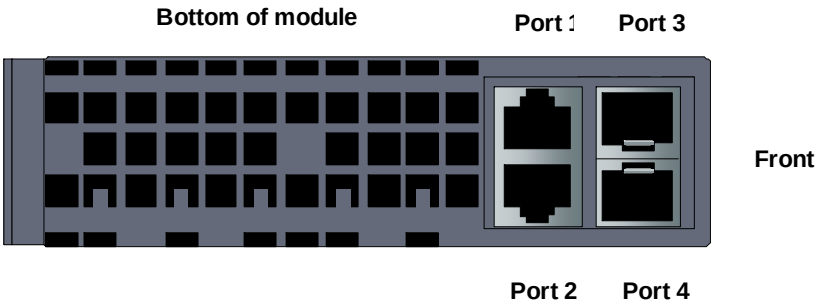
1.3.4 USB Port

The USB Port is used for installing new firmware using the Winloader tool.

1.3.5 Ethernet Port Connections

For other options, refer to Chapter 4, the section Adding and Configuring an Ethernet Port.

Each port on an RX3i PNS operates independently, so devices that operate at different speeds and/or duplex modes may be attached to the ports. By default, all ports, including empty, unconfigured SFP cages, are set for Automatic, which enables auto negotiation for the widest range of options supported by the port.



Connections to the PROFINET Scanner can be made using standard Cat 5e/6 Ethernet cables. Different devices on the same network can be connected using the multiple ports on the RX3i PNS.

1.4 PROFINET Operation Overview

An RX3i PROFINET Scanner (PNS) uses PROFINET communications for data exchange. The same network can also be used for basic Ethernet communications, but use of a separate Ethernet network and RX3i Ethernet interface is recommended.

A PROFINET network can include three types of devices:

PROFINET I/O Controller A PROFINET I/O Controller collects data from I/O devices (inputs), and provides data to the devices (outputs). It is associated with one or more I/O Devices.

PROFINET I/O Device A PROFINET I/O Device is a distributed I/O Device that is coupled to a PROFINET I/O Controller via PROFINET. In an RX3i system, the RX3i PNS operates as an I/O Device, managing initialization, configuration, and communication between the PROFINET controller and the I/O modules.

PROFINET I/O Supervisor An I/O Supervisor can be a programming device, a computer, or an HMI device. The PROFINET I/O Supervisor is typically used for commissioning or diagnostics.

1.4.1 PROFINET Communications

Communications on an RX3i PROFINET network use the standard PROFINET communications described in this section.

1.4.2 Application Relationships

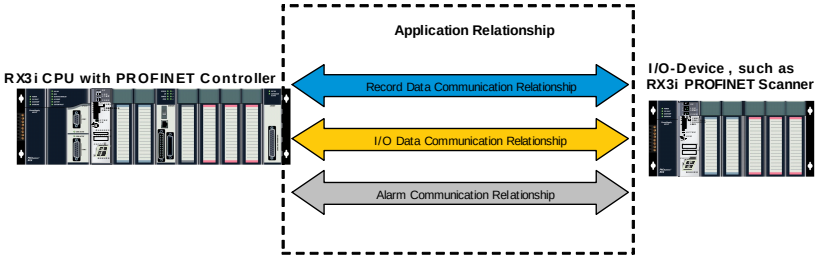
Before a PROFINET I/O Controller can exchange data with a PROFINET I/O Device such as the RX3i PNS, an Application Relationship (connection) must be established between the devices. The PROFINET I/O Controller automatically sets up the correct number and types of Application Relationship and Communication Relationship channels (refer to the following section) based on its Proficy Machine Edition configuration. Usually, only one Application Relationship is established per I/O Device.

1.4.2.1 Communication Relationships within an Application Relationship

Within each Application Relationship (AR), the PROFINET I/O Controller establishes the following types of Communication Relationships (CRs):

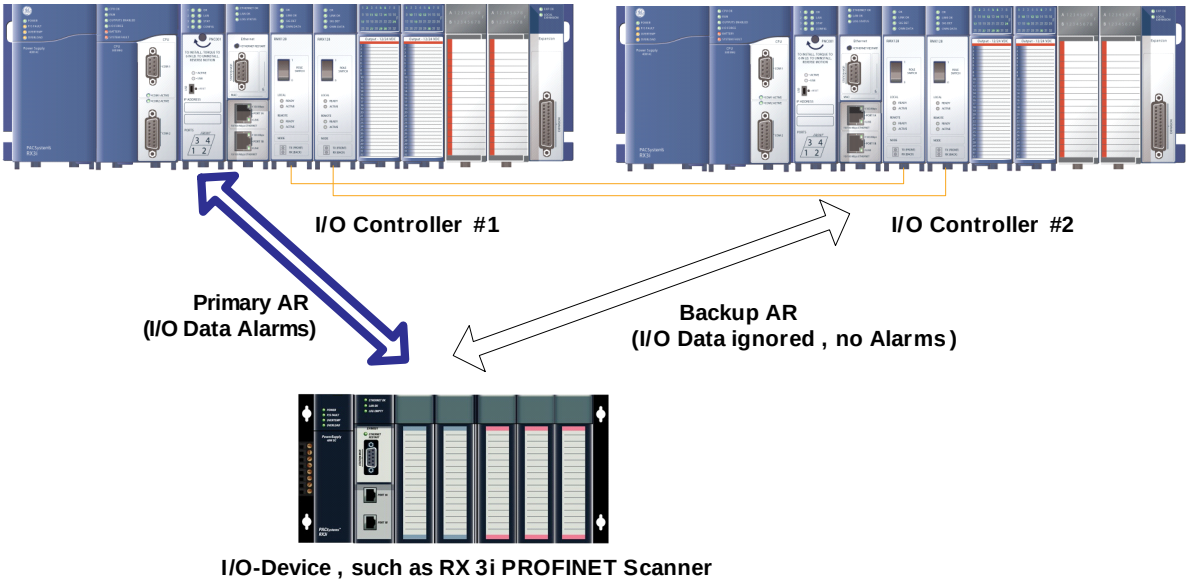
- **Record Data CRs** – always the first to be established within an Application Relationship. Record Data Communication Relationships are used for non-real-time transfers of data records such as startup parameter data, diagnostics data, identification data, and configuration data
- **I/O CRs** – used for the real-time, cyclic transfer of I/O data
- **Alarm CR** – used for real-time, acyclic transfer of alarms and events

The illustration below represents an Application Relationship between a PACSystems RX3i CPU with an RX3i PNC module and an I/O Device. In this example, the I/O Device is an RX3i PNS with RX3i and 90-30 I/O modules, but the same principles apply for all I/O Controllers and I/O Devices.



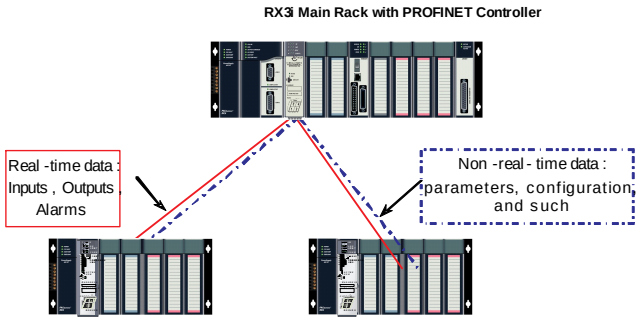
1.4.2.2 Application Relationships and PROFINET System Redundancy

The RX3i PNS supports a special type of relationship that allows two matched connections from two different PROFINET I/O Controllers to exist at the same time. These two connections form a redundant AR set in which one connection serves the Active controlling unit and one serves the Backup unit. Only one of the I/O Controller is the Active unit at any one time. The I/O Controllers collectively determine which connection is Active and which is Backup. I/O Data and Alarms are transferred only to the Active unit.


I/O Controller #1
I/O Controller #2
Primary AR
(I/O Data Alarms)
Backup AR
(I/O Data ignored , no Alarms)
I/O-Device , such as RX 3i PROFINET Scanner

1.4.3 Types of PROFINET Communications

PACSystems PNS modules use two types of PROFINET communication transfers: real-time and non-real-time. The illustration below shows real-time communications as solid lines and non-real-time communications as dashed lines.



- **Real-Time (RT) communication**: PROFINET real-time communication is used for time-sensitive data. A PROFINET I/O Controller and PROFINET I/O Device use two types of real-time communications to exchange data: cyclic communication and acyclic communication:
  - Real-time Cyclic communication is used to periodically transfer the application's input and output data. Cyclic communication occurs each PROFINET I/O production cycle.
  - Real-time Acyclic communication is used to transfer non-periodic data such as alarms. Acyclic communication occurs only when needed.
- **Non-Real-Time (NRT) communication**: PROFINET non-real-time communication is used for less time-sensitive data such as configuration, parameterization, diagnostics, and identification data.

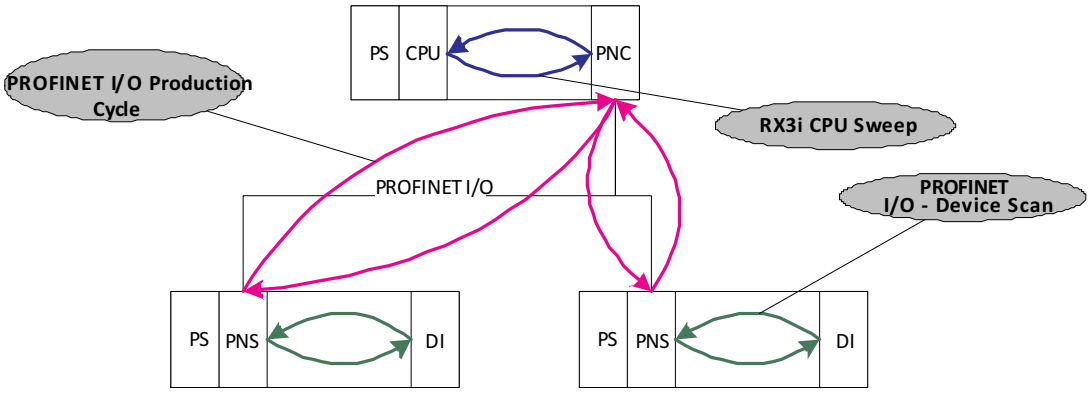
1.4.4 Operations of the PROFINET Scanner

The RX3i PNS performs the following operations:

- Consumes PROFINET I/O Device configuration from the PROFINET I/O Controller over the PROFINET network and applies it to its modules.
- Scans input data from each module it manages and produces that data to the PROFINET I/O Controller.
- Consumes the output data that it receives from the PROFINET I/O Controller and applies it to each module it manages.

1.4.5 I/O Scanning

In the PACSystems RX3i PROFINET network, multiple I/O cycles run asynchronously and independently. The example below illustrates typical cycles in a system with an RX3i CPU with a PNC module, and RX3i PNS modules used as I/O Devices. Cycles may be different for third party devices.



- **PROFINET I/O Device Scan**: In this example, each PNS scans all of its I/O Modules as quickly as possible. The PNS stores the modules' input data into its internal memory. On each PNS output scan, the Scanner writes the output data from its internal memory to its I/O modules.
  Third-party devices: The transfer of I/O data between an I/O module and the PROFINET I/O network is device dependent. Refer to the third-party manufacturer documentation for specifics for a particular device.
- **PROFINET I/O Production Cycle**: Each PNC and I/O Device publishes data from its internal memory onto the network at its scheduled PROFINET production cycle (Note: Production cycles between I/O Controllers and I/O Devices are not synchronized; each publishes at its configured update rate independently). The PNC publishes output data received from the RX3i CPU to each I/O Device, and the I/O Device publishes input data from its memory to the PNC.
- **RX3i CPU Sweep**: The RX3i CPU Sweep includes both an input scan and an output scan. The CPU input scan retrieves the current input data being stored within the PNC module. This input data is then available for use by the application logic. After the logic solution, the CPU output scan writes the outputs to the PNC.

1.4.6 Media Redundancy Protocol Support

PROFINET Media Redundancy Protocol (MRP) supports devices configured in a ring topology. MRP is specified as part of IEC62439 and has been adopted by the PROFINET specification, which provides for convenient configuration of the ring topology and necessary parameters. Like PROFINET IO data, Media Redundancy Protocol operations are not routable between different IP subnets.

Each device within an MRP ring has two physical pathways to the I/O Controller. To connect to the ring, each device requires an integrated switch with at least two external ports (ring ports) that support Media Redundancy Protocol. Devices that are not MRP-capable can be connected to a device in the ring (for example, an MRP-capable switch in the ring), but they should not be in the ring themselves. The redundancy capability offered by the ring topology only extends to the devices on the ring that are MRP-capable and enabled.

One of the devices on the ring must be configured as the Media Redundancy Manager (MRM), and all the other devices must be configured as Media Redundancy Clients (MRCs). The PNS can be configured as an MRC. Configuring the PNS as an MRC alters how the Ethernet ports connect to the network. They attempt to indicate their state to the MRM before allowing traffic to flow between the ports and close the ring topology through the internal switch. They also send out notifications to the MRM when a port is lost. Operation of the PNS is otherwise unchanged.

The MRP configuration is stored in non-volatile storage in the PNS and activated immediately upon powering up. Non-volatile storage is updated as part of a connection with the I/O Controller. A DCP Reset disables MRP Client operation and updates non-volatile storage. The current state of the MRP configuration is provided as part of the PNS's Input Status Bits which are accessible to user application logic. Refer to Chapter 5, the section,*Input Status Bits*, for further details.

Fast ring-break detection is not fully functional until all MRP clients have received their MRP configuration. For a discussion of ring-break detection, refer to the following section *Bumpless Operation with MRP*.

1.4.7 Bumpless Operation with MRP

The RX3i PNS supports bumpless operation with GE Intelligent Platforms PROFINET IO Controllers if specific conditions are met. Bumpless operation means that a single break in an MRP ring will not cause the PROFINET connection to be lost and there is no observed loss and addition of PROFINET IO Devices while the ring network recovers.

Without bumpless MRP, when a device is lost, it must be re-acquired by the IO Controller; a typical recovery time is on the order of seconds.

There are two ways an MRM detects a break in the ring:

- a message from an MRC that provides LinkUp/LinkDown detection
- a test packet timeout interval

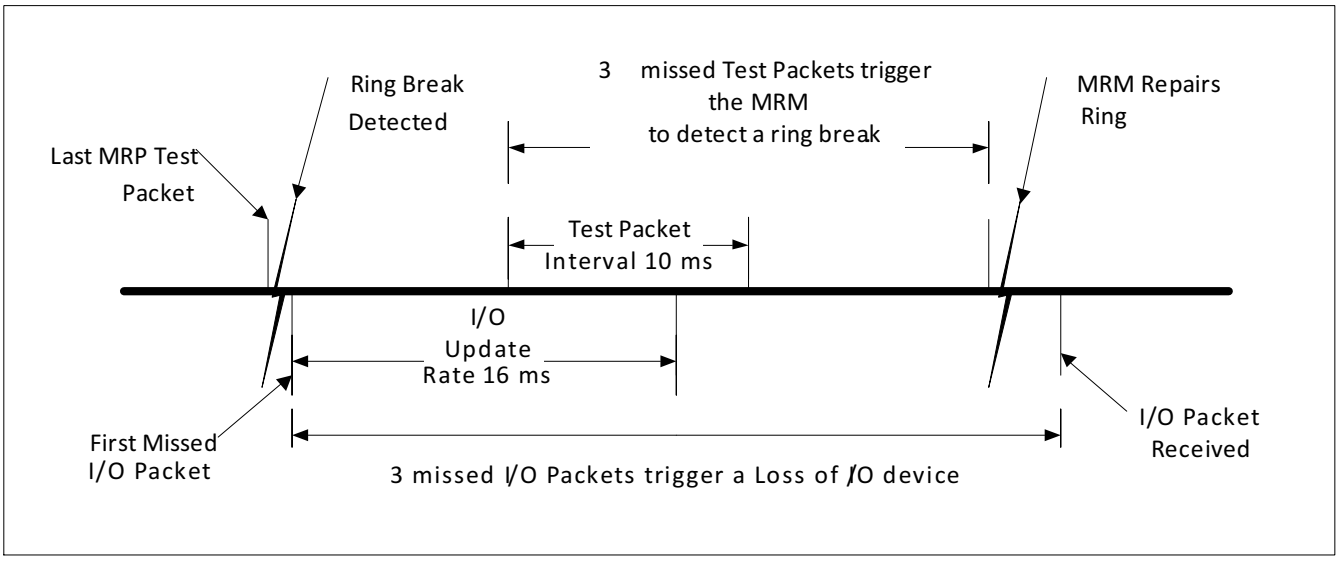
A network using Media Redundancy Protocol recovers from a ring failure within 80 milliseconds when running at 100/1000 Mbps full duplex with default Media Redundant Manager (MRM) test packet values. *Actual failover time* depends on the device responsiveness to network disconnection and reconnection, number of devices in the ring, media speed, length of media, and frequency of sending test frames over the network. Network recovery time is shorter with fewer devices, faster media speed, and shorter media lengths. Third-party devices in the MRP ring may introduce additional network recovery time. Network recovery time is limited by the ring participant with the slowest ring failure recovery time. Devices that do not provide LinkUp/LinkDown detection should be taken into account when calculating network recovery time.

For bumpless network recovery (without disturbing I/O communications to an I/O Device), the I/O Update Rate for the I/O Device should be configured to be greater than 1/3 of the network recovery time. This permits the ring to be disconnected or reconnected without timing out the communication connection between the I/O Device and its I/O Controller In order to insure correct MRP operation, it is important to connect the correct Ethernet ports of the PNS to the MRP ring. The ports connected to the ring must be the same ports configured as MRP Ring Ports. Failure to connect the configured ports will prevent the PNS from correctly participating in the MRP ring. To assist with configuration of the ports during system commissioning, it is recommended that you disable all device ports that will not be used as ring ports.

1.4.8 MRP Operation for I/O Update Rates of 16 ms or greater

The RX3i PROFINET I/O Controller supports bumpless operation at 16ms with the requirement that the MRP Manager be configured for an MRP Test Packet Interval and MRP Test Packet Count that is faster than the fastest I/O timeout possible.

For example:
Assume the worst case scenario when a ring break occurs immediately after the PNS received a test packet and immediately before the PNS was scheduled to receive an I/O packet. In the case of a 16 ms I/O Update Rate, a timeout will occur after three consecutive missed I/O packets, which can occur in slightly over 32 ms. Assuming that the Test Packet Interval is configured for 10 ms and the Test Packet Count is configured for two, we can detect a ring break in just less than 30 ms. This ring recover scenario would look like the following timeline.



In order to ensure a successful ring recovery using the Test Packets at a 16 ms I/O Update Rate or above, make sure the following statement is true:

Test Packet Interval × (Test Packet Count + 1) < I/O Update Rate × 2

1.4.9 MRP Operation at I/O Update Rates less than 16 ms

The RX3i PNS implementation of MRP supports LinkUp/LinkDown detection, an optional part of the MRP standard. This allows an MRC experiencing a network link failure or recovery to send LinkUp/LinkDown messages to the MRM immediately. The MRM can heal the network without needing to wait for multiple test-packet timeouts to detect the failure. This feature allows the network recovery time to be significantly shorter than the test packet timeout interval because the break is detected immediately.

1.4.9.1 Forcing 100 Mbps to Obtain Bumpless Ring at I/O Update Rates of 2, 4 and 8 ms

The standard, *IEEE 802.3 Clause 40*, has a requirement for link detection at 1 Gbps that can be as slow as 750 ms, which is too slow to reconfigure a ring before three consecutive I/O packets are missed.

The RX3i PNS uses a fast link detection feature on its non-SFP ports that allows two RX3i devices connected to each other at 1 Gbps to detect a link break fast enough to perform bumpless I/O recovery at a 2, 4 or 8 ms update rate. If the RX3i PNS is connected to any other device that does not support fast link detection at 1 Gbps speeds, the RX3i PNS' MRP ring port can be configured to limit that port to operate at 100 Mbps. This will force the device connected to the RX3i PNS to operate at 100 Mbps which has a much faster link detection time. See the *Adding and Configuring an Ethernet Port* in the *Configuration* chapter for how to set a port to 100 Mbps.

1.4.10 Minimum I/O rate when Configured in an MRP ring

For RX3i PNC operating specifications, refer to GFK-2571, PACSystems RX3i PROFINET Controller Manual.
For operating specifications of the RXi Controller's embedded PNC function, refer to GFK-2816, PACSystems RXi ICRXICTL000 Distributed I/O Controller User's Manual.

The minimum I/O rate that is possible for bumpless operation depends on the speed and the type of physical connection being used for the MRP ring ports. PACSystems PROFINET I/O Controllers support a specified number of GE Intelligent Platforms PROFINET IO devices running at or above the minimum I/O Update Rate listed in the table below.

1.4.11 Minimum I/O Rates for Bumpless RX3i PNS Recovery

Connection Type	Minimum IO Update Rate		Minimum IO Update Rate	
	1 Gb/s	# of Devices	100 Mb/s	# of Devices
Fixed Copper Port	2ms	16	2 ms	16
1000Base-LX	16 ms[1]	63	N/A[2]	N/A
1000Base-ZX	16 ms[1]	63	N/A[2]	N/A
100BaseL-X10	N/A[2]	N/A	16 ms[1]	63
1000Base-SX	16 ms[1]	63	N/A[2]	N/A
100BaseFX	N/A[2]	N/A	16 ms[1]	63
1000BaseT	16 ms[1]	63	16 ms[1]	63

[1]	The 1000BaseT SFPs qualified for use with the RX3i PNS can only detect a ring break when running at 1 Gb/s at the IEEE 802.3 Clause 40 standard requirement of 750 ms. The Fiber SFPs can only detect a ring break at the SFF-8472 RX_LOS assertion time of 100 ms. In order to do bumpless I/O at a 16 ms I/O Update rate with these SFPs, the MRM must be configured with a Test Packet Interval of 10 ms and a Test Packet Count of 2.
[2]	These devices operate at a fixed speed and duplex.

1.4.11.1 Third-party PROFINET Devices as MRP Clients

If 3rd-party PROFINET Devices configured as MRP Clients are in use in the ring, customers can set a minimum I/O update rate to the larger of the options below and expect I/O to operate bumplessly through ring network recovery:

- Minimum I/O Update Rate configurable in PME that is more than 1/3 the time of the worst-case ring recovery stated by 3rd-party manufacturer, regardless of ports utilized. (For example, if a manufacturer states their worst-case ring recovery is 96 ms, then the minimum I/O Update Rate allowed must be greater than 96/3 = 32 ms, therefore select the next available value, 64.)
- 16 ms I/O Update Rate minimum, regardless of ports utilized, and must set MRP Test Packet Interval to 10 ms and MRP Test Packet Count to 2

1.5 System Limits

I/O Controllers will have limitations on the system they support. One of these limits is the number of PROFINET submodules supported. In the RX3i PNS rack, each power supply or I/O module is represented by one PROFINET submodule. The RX3i PNS uses four to six submodules:

- two submodules for basic operation of the PNS module
- two built-in port submodules that are always configured
- up to two additional port submodules, one for each optional Ethernet port configured

Other limitations, such as the configuration and I/O sizes, are specific to the configuration options chosen. Note that not every combination of options is supported in every system. If the configuration uses all slots in every device with a large device count, the memory of the I/O Controller system will be a limiting resource.

1.6 Supported Modules, Power Supplies and Backplanes

For a list of modules, power supplies and backplanes that can be used with an RX3i PROFINET Scanner I/O Device, refer to the Important Product Information document provided with the firmware version on your PNS module.

2 LED Operation and Connector Details

This chapter describes:

- LEDs
- Ethernet Network Ports
- SD Card Slot
- USB Port

2.1 Normal Operation of Individual LEDs

2.1.1 OK LED

Green ON	OK
OFF	Not OK

2.1.2 LAN LED

The LAN LED indicates access to and activity on the Ethernet network. The LAN LED indicates network packets are being processed by the network interface (not just passing through the embedded switch).

Blinking ON	The module's network interface is active
OFF	No activity

2.1.3 Status LED

The STATUS LED stays green during normal operation.

Green, ON	Normal Operation
Red, blinking	A MAC address read from nonvolatile memory is invalid. Ports with invalid MAC addresses remain disconnected from the Ethernet network.

2.1.4 CONN LED

The CONN LED indicates the status of PROFINET connections.

Green, ON	At least one PROFINET connection (AR) exists with an I/O Controller
Amber, blinking	No device name configured
OFF	No PROFINET connection (AR) exists.

2.1.5 Port LEDs

The PROFINET I/O Scanner has four Port LEDs, PORT1, PORT2, PORT3, and PORT4 that indicate link speed, link connection and link activity corresponding to the four possible external Ethernet ports.

Blue, ON	Link connected, 1000 Mbps
Blue, blinking	Port active, 1000 Mbps
Green, ON	Link connected, 100 Mbps
Green, blinking	Port active, 100 Mbps
Purple, ON	Link connected, 10 Mbps
Purple, blinking	Port active, 10 Mbps
OFF	The associated Ethernet port is not connected to an active link (can be disabled by configuration)
Red, ON	Port 3 and port 4 only. Incompatible SFP plugged into port.

2.1.6 Active LED

The Active LED indicates the Scanner is connected to a PROFINET IO Controller that is controlling the IO data for the PNS's I/O modules.

Green, ON	PNS is connected to a PROFINET I/O Controller that is controlling IO Module IO data.
OFF	PNS is not connected to a PROFINET I/O Controller or no established connection to an Active I/O Controller.

2.1.7 USB LED

Green, ON	A USB cable is connected.
Green, blinking	USB port activity
OFF	No USB port activity

2.1.8 Special LED Blink Patterns

The PNS's LEDs can operate in tandem to indicate fatal error, module location/identification, microprocessor over temperature, and update conditions, as described below. There is also a startup sequence that tracks the startup processing of the module with the LEDs.

2.1.8.1 Fatal Error Codes

When the PNS encounters a fatal error, it will blink an error code pattern on the OK LED with an Amber color or on the STATUS LED with a Green color. In this mode all LEDs flash Green once to indicate the start of the error code. Next the OK or STATUS LED blinks a 4-digit decimal error code. The LED first blinks to indicate the most significant error digit, then after a brief pause blinks again to indicate the next significant error digit and so forth. After another brief pause, all LEDs flash Green again and the error code pattern repeats. Repetitions continue indefinitely until the module is power-cycled.

2.1.8.2 Module Identification

The LEDs on a PNS module can be commanded to repeatedly turn ON and OFF in a special sequence, to help locate or identify the module:

- First the green LEDs are turned on in the following circular order: OK, LAN, STATUS, CONN, PORT 4, PORT 3, PORT 2, PORT 1. There is a short delay between turning on each LED.
- The LEDs are then turned off in the same order. There is a short time delay between turning off each LED.

The Module Identification LED Pattern is initiated by the PROFINET DCP Identify Device command. Module Identification can be initiated using the Proficy Machine Edition Discovery Tool by refreshing the device list, double clicking on the RX3i PNS module, and clicking the Identify Device button on the PNS properties pop-up window.

2.1.8.3 Microprocessor Over Temperature

If the maximum threshold temperature for the PNS's microprocessor is crossed, the PNS goes into power-saving mode. While the PNS is in an over temperature condition, the following blink patterns are alternated:

- PORT 1, PORT 2, and STATUS LEDs turn on RED for 0.5 seconds (all other LEDs off)
- Then PORT 3 and PORT 4 LEDs turn on RED for 0.5 seconds (all other LEDs off)

The PNS stays in power-saving mode until the temperature drops to a safer level. Once a safe temperature is reached, the PNS module restarts.

Note Under certain ambient operating temperatures, the PNS may momentarily display the over temperature pattern during power up while it is calibrating its thermal protection functions. This indication can be ignored.

2.1.8.4 Firmware Update

While the PNS is in firmware update mode, the OK, LAN, and STATUS LEDs blink Green for 0.5 seconds and then off for 0.5 seconds in unison. During firmware update operation, the ports are disabled, so all of the PORT LEDs are off and the CONN LED is off. The USB LED operates normally displaying the condition of the USB port.

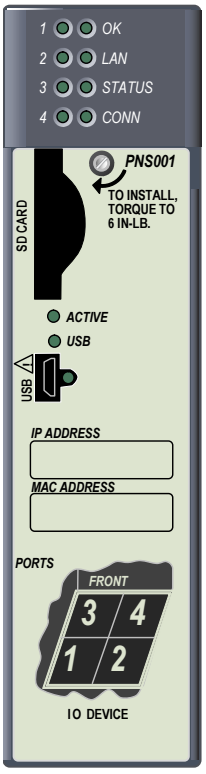
2.1.8.5 Internal Update

Some changes from a firmware update are applied to the system on the next power up. During this internal update process, the STATUS and LAN LEDs blink Green for 0.5 seconds and then off for 0.5 seconds in unison. At the completion of the internal update process, the PNS restarts and should power up normally.

2.1.8.6 Powerup LED Patterns

At powerup, the LEDs show the patterns described below. The LEDs also blink diagnostic patterns for certain operating errors and for module identification. See the *Special LED Blink Patterns* section for a description of the special blink patterns.

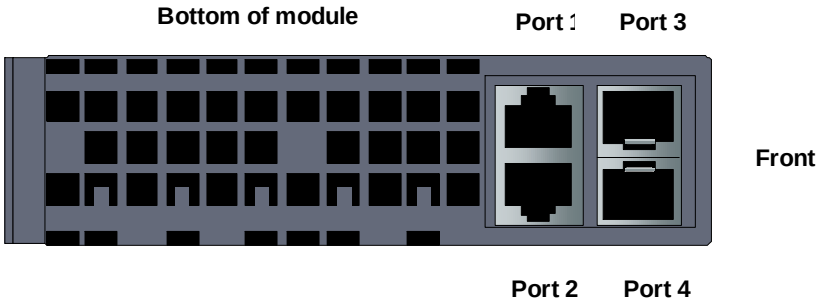
Step	LED/Blink Pattern	Description
1	All LEDs off	Initial state
2	STATUS LED solid green	Normal operation
	OK LED blinks amber with special blink code	Fatal initialization or diagnostics Failure; H/W Module Identity Information not available
	STATUS LED blinks green with special blink code	Fatal initialization failure.
	OK, LAN, and STATUS LEDs blink green in unison (0.5 second ON/ 0.5 second OFF)	Invalid firmware detected or firmware update initiated. Module is waiting for firmware update. Blink pattern continues during firmware update. After the automatic update completes, the LAN and STATUS LEDs blink Amber and the module resets, which restarts the powerup process.
	STATUS and LAN LEDs blink green in unison (0.5 seconds ON/ 0.5 seconds OFF)	Internal update in process following a firmware update. Unit should complete update and restart automatically.
3	LAN and STATUS LED solid green	Normal operation
4	OK LED solid green	Normal operation. Powerup completed.



Note Under certain ambient operating temperatures, the PROFINET Scanner may momentarily display the over temperature pattern during power up, while it is calibrating its thermal protection functions. This indication can be ignored. For details, refer to the section,*Microprocessor Over Temperature*.

2.2 Ethernet Network Ports

The four external Ethernet ports (two RJ-45 and two SFP Cages) are on the bottom of the module. The illustration below is a bottom view of the RX3i PNS with its two RJ-45 and 2 Small Form-factor Pluggable (SFP) ports.



The RX3i PNS's two RJ-45 ports provide 10/100/1000 Mbps copper interfaces and two SFP cages for user-supplied SFP devices, which can support a number of different media types. Refer to *SFP Modules for Ethernet Ports* in the *Installation* chapter for additional information about SFPs. The two RJ-45 ports support CAT5e/6 cabling of up to 100m. Each Ethernet port automatically senses the type of network and adjusts speed and connection parameters. The PROFINET protocol can be sent and received over any or all of the four external ports.

Devices connected to the PROFINET Scanner ports should have Ethernet Autonegotiation enabled. The Ethernet ports can be disabled to support requirements such as IT policies for unused ports. Disabled ports do not establish a link on their Ethernet network. RX3i PNS modules and other participating modules can be connected in a daisy chain/line, or star topology. The ports can also be configured to limit their advertised Autonegotiation setting. This can be used to force a copper interface to establish a link at 100 Mbps rather than 1 Gbps to have quicker link change detection during MRP operation.

Caution

Multiple ports on the Ethernet Interface must not be connected, directly or indirectly, to the same device so as to form a circular network.

Caution

Port disable settings are nonvolatile. If an SFP port is configured as the only enabled port and that SFP is removed, the RX3i Scanner will not be accessible until an SFP is returned to that port.

2.3 SD Card Slot

The SD Card Slot, located on the front of the PROFINET Scanner, can be used to transfer the I/O Device Name from a different PROFINET Scanner without the need for a configuration tool such as PME to commission the new hardware. A card is not required to be present. See *Transferring the IO-Device Name with an SD Card* in the *Configuration* chapter for more details.

Note that when installing an SD Card, the label should face to the left with the write-protect (Lock) switch to the bottom. The card should enter easily and click when fully inserted. The spring action will return the card back slightly from its fully depressed position. Do not force the card into the slot as that can damage the unit. To release the card, press the card in again until it clicks, and the spring action will eject the card out enough to easily grab hold of it.

SD and SDHC capacity cards are supported. An SD Card can be formatted as either FAT12 or FAT16 per the SD Card standard and an SDHC card should be formatted using FAT32 per the SD Card standard.

2.4 USB Port

The USB port, located on the front of the PROFINET Scanner, can be used to connect a computer for firmware updates for the PROFINET Scanner. The USB port accepts a standard USB cable (USB Micro B Male to USB Type A Male, not included). The port must be set up before using it, as described in the Operations chapter.

Note The USB port is for firmware upgrades only. It is not intended for permanent connection.

Notes

3 Installation

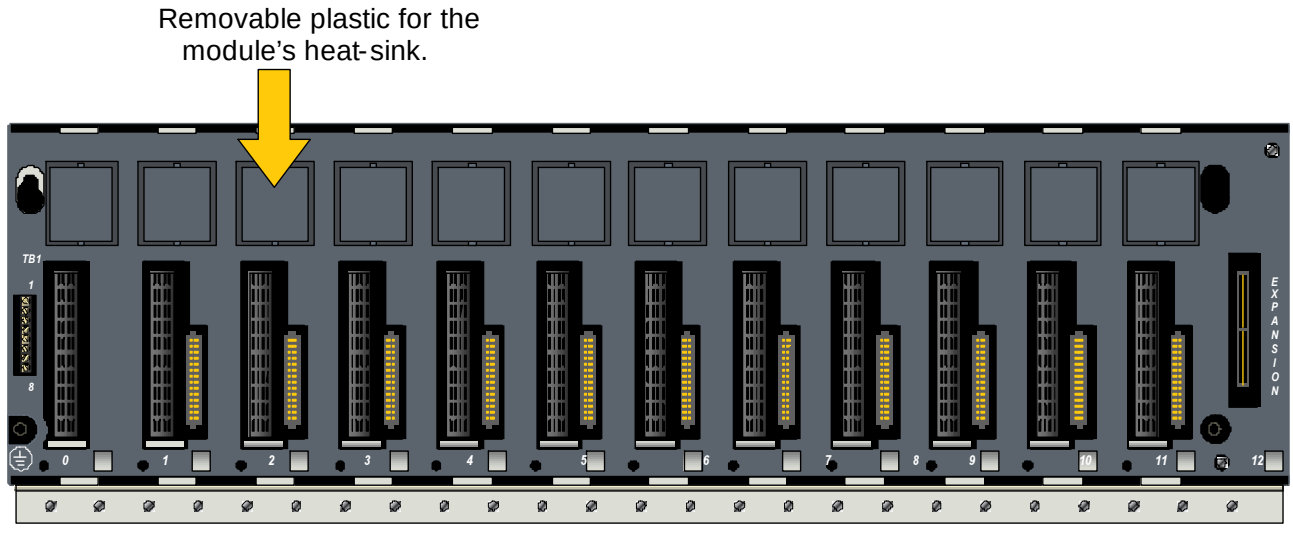
This chapter describes:

- Module Installation
  - Backplane Knockout Removal
  - Module Insertion
  - Module Removal
  - Power Requirements
- Replacing PROFINET Scanner Hardware
  - Method 1 – Using the SD Card
  - Method 2 – Using the DCP Tool
- SFP Modules for Ethernet Ports
  - Network Cabling and Connector Types
  - Network Cabling and Connector Examples
- External Switch VLAN Priority Settings

3.1 Module Installation

3.1.1 Backplane Knockout Removal

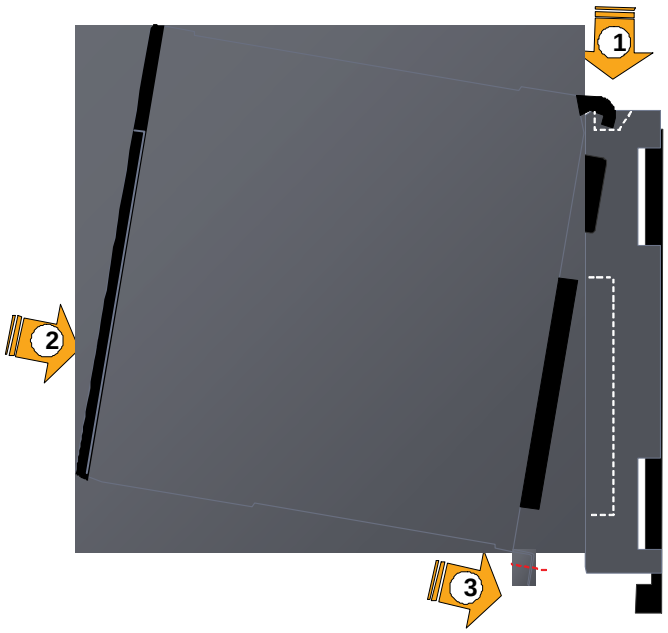
The PNS must be installed in a Universal Backplane such as IC695CHS007, CHS012 or CHS016. The back of the PNS has an exposed heat sink and backplane connector. Before inserting the module into the backplane, remove the plastic knockout in the slot where the module will be placed. The installation slot must match the slot that is selected in the module's hardware configuration



3.1.2 Module Insertion

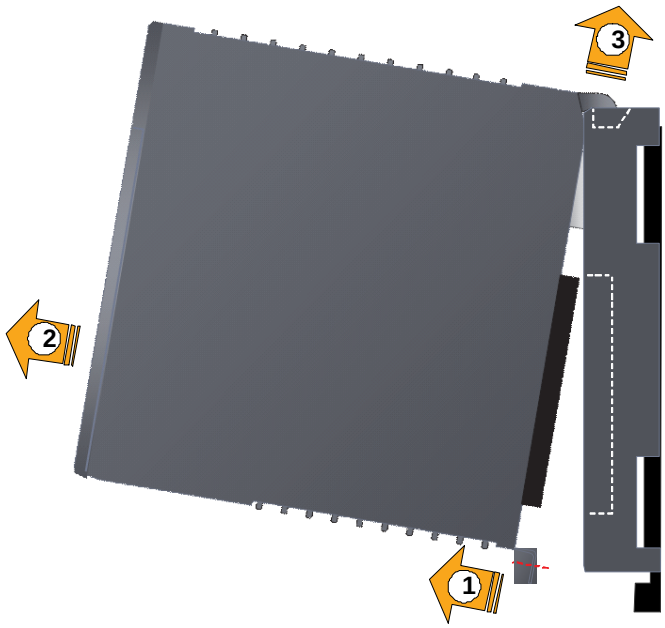
The PNS can be installed in slot 1 or 2 of a 7, 12, or 16-slot RX3i Universal Backplane, or in slot 6 of a 7-slot RX3i Universal Backplane. The back of the PNS has an exposed heat sink and backplane connector. Before inserting the module into the backplane, the removable conduction cooling cover must be removed from the backplane.

- RX3i rack power must be turned off. The PNS does not support insertion/removal while power is applied to the system (hot swap).
- Holding the module firmly, align the module with the correct slot and connector.
- Engage the module's rear pivot hook in the notch on the top of the backplane (1).
- Swing the module down (2) until the module's connector engages the backplane's backplane connector.
- Visually inspect the module to be sure it is properly seated.
- Secure the bottom of the module to the backplane using the machine screws provided with the module (3).
- Tighten the heat sink screw on the front of the module in the threaded hole in the backplate to 6 in lbs, using a flat-tip screwdriver.



3.1.3 Module Removal

- RX3i rack power must be turned off.
- Loosen the heat sink screw on the front of the module to release the heat sink from the backplane's aluminum backplate.
- Loosen the screws at the bottom of the module (1).
- Pivot the module upward until its connector is out of the backplane (2)
- Lift the module up and away from the backplane to disengage the pivot hook (3).



3.1.4 Power Requirements

More than one power supply may be required to support some configurations. To determine the system loading, refer to GFK-2314, the table, *Module Load Requirement* and total the 3.3 v and 5 v needs of the system.

3.2 Replacing PROFINET Scanner Hardware

If a PNS module needs to be replaced for any reason, the steps to commission a new hardware module are listed below.

Note If the replacement PNS module has no assigned name (the CONNECT LED is blinking Amber slowly), the network cabling can be plugged back in and the name assigned over the I/O network.

If there is a possibility of duplicate names existing on the network due to a pre-existing I/O Device name assigned in the replacement module and the name will not be transferred via the SD Card, the I/O Device Name should be assigned before inserting it into a working I/O network. The I/O Device Name and IP Address settings can be updated offline (for example, in an office setting).

You should only use the Proficy Machine Edition DCP Tool to store the I/O Device name to the RX3i PNS' SD Card and avoid hand-editing I/O Device name files contained on the RX3i PNS' SD Card. Storing an illegal name to the RX3i PNS will prevent it from connecting to its PROFINET I/O Controller until a valid name is stored.

3.2.1 Method 1 – Using the SD Card

1. Remove power from the PNS module. This should be done before network cabling is removed, especially in the case of fiber connections.
2. Remove network cabling from the module.
3. Remove the SD Card from the module.
4. Remove the module.
5. Insert the replacement PNS module.
6. Insert the SD Card from Step 3 in the replacement PNS module.
7. Connect network cabling to the replacement PNS module.
8. Apply power to the replacement PNS module hardware. The I/O Controller will update any IP address settings automatically when it connects.

3.2.2 Method 2 – Using the DCP Tool

Also see *Assign an I/O Device Name* in the *Configuration* chapter

1. Remove power from the PNS module. This should be done before network cabling is removed, especially in the case of fiber connections.
2. Remove network cabling from the module
3. Remove the module.
4. Insert the replacement PNS module.
5. Connect network cabling to the replacement PNS module.
6. Apply power to the replacement PNS module hardware.
7. Using the utility *PROFINET DCP* click on the Refresh Device List command button.
8. Highlight the row representing the newly inserted PNS.
9. Click on the *Edit Device* command button and type in the device name.
10. Click on the *Set Device Name* command button.

3.3 SFP Modules for Ethernet Ports

Each Small Form-factor Pluggable (SFP) cage on the bottom of a PROFINET Scanner module is capable of accepting a 10/100/1000 Mbps copper SFP, 100 Mbps Single-Mode Fiber SFP, 100 Mbps Multi-Mode Fiber SFP, 1000 Mbps Single-Mode Fiber SFP, or 1000 Mbps Multi-Mode Fiber SFP device. The RX3i PROFINET Scanner supports the SFP devices listed below. An SFP type other than those listed below can be configured as a Generic SFP. The RX3i PROFINET Scanner will attempt to operate with a Generic SFP that identifies itself as an Ethernet SFP. A substitution alarm is generated if the wrong SFP is inserted, but the Scanner attempts to operate with it. Since SFP types other than those listed below have not been validated, correct operation cannot be guaranteed.

Optical SFPs use an invisible laser to generate a fiber-optic signal. Always keep the port covered if a cable is not installed. Do not look into the open port if a cable is not installed.

If the surrounding air operating temperature of the PNS is greater than 40 °C, SFP devices could have operating temperatures over 70 °C (158 °F). Under these conditions, for your safety, do not use bare hands to remove an SFP device from the SFP cage. Use protective gloves or a tool (needle-nose pliers) to avoid handling the hot SFP device directly when removing the SFP device.

3.3.1 SFP Module Types

SFP Type	Wavelength (nm)	Media Type	Core Size (µm)	Modal Bandwidth (MHz – Km)	Distance (m)
100BASE-FX (IC695SPF002)	1300	MMF	62.5	500	2 – 2,000 (Full-Duplex) 2 – 400 (Half-Duplex)
			50	400	
			50	500	
100BASE-LX10 (IC695SPF010)	1300	SMF	9	-	2 – 10,000
1000BASE-SX (IC695SPF550)	850	MMF	62.5	160	2 – 220
				200	2 – 275
			50	400	2 – 500
				500	2 – 550
1000BASE-LX	1300	SMF	9	-	2 – 10,000
1000BASE-ZX[1]	1550	SMF	9	-	2 – 70,000

SFP Type	Wavelength (nm)	Media Type	Core Size (µm)	Modal Bandwidth (MHz – Km)	Distance (m)
10/100/1000BASE-T (IC695SPC100)	-	CAT5e/CAT6	-	-	100 (maximum)

[1] It may be necessary to use a signal attenuator with shorter cable lengths in order to reliably establish a link due to the high power output of the 1000BASE-ZX SFPs.
The Scanner does not distinguish between 1000Base-LX and 1000Base-ZX, so no substitution alarm is generated on mismatches between these two types.

3.3.2 Typical SFP Modules

Below are images of the two types of Ethernet SFPs. The Single- and Multi-Mode Fiber SFPs accept an LC Connector. The Copper SFPs accept an RJ-45 connector.

Fiber

Copper

3.3.3 Network Cabling and Connector Types

Copper: up to 100 Meters between Devices

All GE Intelligent Platforms products use RJ-45 connectors for copper connections. Copper cabling and connections are easily available in the general market and support distances of up to 100 m.

Multi-Mode Fiber: up to 2 Km between Devices

Multi-Mode Fiber supports two types of connectors, LC and SC. The LC connector is used on SFPs on the RX3i PNC and PNS. The SC connector is used on the VersaMax PNS. Cables are available with LC-to-LC connectors and LC-to-SC connectors to match the different connector formats. Multi-Mode fiber can support distances up to 2 Km at 100 Mbps. When using fiber, pay particular attention to the cable connector and cable radius clearance requirements in cabinet planning and layout.

Single-Mode Fiber: up to 70 Km between Devices

Single-Mode Fiber is supported between SFPs using the LC connector. Single-Mode fiber can support distances up to 70 Km. As with the Multi-mode fiber, pay attention to the cable connector, radius, and minimum length requirements in planning the installation.

3.3.4 Network Cabling and Connector Examples

CAT5e/CAT6 (shielded or unshielded) with RJ-45 Connector

Multi-Mode Fiber with LC Connector

Single-Mode Fiber with LC connector

3.4 External Switch VLAN Priority Settings

If a system includes external switches, these switches must be configured to match the VLAN Priority groupings listed below for the PNS.

The PROFINET I/O specification indicates the VLAN priorities for each type of Ethernet traffic that originates from a PROFINET I/O Device. VLAN priorities range from 0 to 7, with 7 being the highest.

The switch on an RX3i PNS supports just four traffic classes, giving four levels of preference. Incoming traffic without a VLAN priority is assigned to the lowest priority traffic class. The table below lists the VLAN priorities, and their corresponding priorities in the PNS:

VLAN Priority	PROFINET IO-Scanner Priority	Ethernet Traffic	Description
7	Highest priority	MRP	Media Redundancy
6	Second-highest priority	RT_CLASS_1	Cyclic PROFINET I/O
		High Priority RTA_ CLASS_1	High-Priority PROFINET Alarms
5	Third-highest priority	Low Priority RTA_CLASS_ 1	Low-Priority PROFINET Alarms
4, 3, 2, 1	Lowest priority	(reserved)	(reserved)
0		IP DCP	Device Discovery and Configuration

Notes

4 Configuration

This chapter provides general information for configuring an RX3i PNS and its I/O modules in a PROFINET I/O network.

This chapter discusses the following topics:

- Configuration Overview
  - Basic Configuration Steps
  - Configuration Tool
- Adding an RX3i PROFINET Scanner to a LAN
  - Configuring RX3i PROFINET Scanner
  - Adding RX3i Modules to a Remote Node
    - Adding a Power Supply
    - Adding and Configuring an Ethernet Port
    - Configuring Module Parameters
    - Configuring Analog Modules that have DIP Switches
    - onfiguring Analog Modules that have Jumpers
- Assigning I/O Device Names
  - Transferring the I/O Device Name with an SD Card
- After the Configuration is Stored to the PROFINET I/O Controller

4.1 Configuration Overview

The RX3i PNS receives its configuration from a PROFINET I/O Controller, which is configured by a PROFINET I/O configuration tool. The GSDML files are provided with Proficy Machine Edition. For other PROFINET I/O configuration tools, the PNS GSDML must be imported. The RX3i PNS GSDML can be obtained by contacting GE Intelligent Platforms Technical Support.

Note For details on using the Proficy Machine Edition PLC Logic Developer programmer to create and download the configuration for an RX3i PROFINET network and its I/O devices, refer to GFK 2571, *PACSystems RX3i PROFINET Controller Manual*.

4.1.1 Basic Configuration Steps

The basic configuration steps are:

- Configure a PROFINET I/O Controller and its PROFINET LAN using the I/O Controller manufacturer's recommended PROFINET I/O configuration tool.
- Configure the parameters of the PROFINET I/O Controller.
- Add I/O Devices to the LAN.
  PROFINET Scanners and other types of I/O Devices use GSDML files to describe their capabilities. The PROFINET I/O configuration tool imports these GSDML files and incorporates the devices into the configuration.

  Note These I/O Devices can be VersaMax or RX3i PROFINET Scanner modules or third party I/O Devices.

- Configure the parameters of the RX3i PROFINET Scanner.
- Configure the communications properties of the PROFINET I/O Controller and RX3i PROFINET Scanner.
- Add RX3i/Series 90-30 modules to the RX3i PROFINET Scanner.
- Configure the parameters of the modules.
- When the configuration is ready, use a DCP tool to assign a name to the RX3i PROFINET Scanner so the PROFINET I/O Controller can connect to it and deliver the configuration.
- Store the configuration data from the configuration tool to the PROFINET I/O Controller.

4.1.2 Configuration Tool

The configuration tool used to configure the PROFINET LAN containing the PNS module must support I/O Devices configured with GSDML V2.3 files.

4.2 Adding an RX3i PROFINET Scanner to a LAN

Use the PROFINET I/O configuration tool to add a PNS module to the LAN. This process may include importing the PNS module's GSDML file. Seven versions of the PNS are available, based on the backplane size and which slot the PNS is to be placed in. They are identical in all regards, except the number of slots available to add IO devices and the slot the PNS is in. Select the version that corresponds to the backplane to be used and where the PNS will be inserted. The PNS is fixed when the device is created and cannot be moved. If the PNS is moved to a different slot, a new device must be created in the configuration.

4.2.1 Configuring an RX3i PROFINET Scanner

The PROFINET I/O Scanner has 32 bits of Status data and 32 bits of Control data. These should be mapped to the I/O Controller's memory. For definitions of these bits, refer to Chapter 5, the section *PROFINET Scanner Status and Control Data*.

The I/O Controller determines the state of the inputs when the PNS is unable to provide them. This could happen when the PNS is not powered on, not connected to the network, or there is a network or configuration issue such that the I/O Controller cannot communicate with the PNS. GE Intelligent Platforms' I/O Controllers support defaulting inputs to Force Off or Hold Last State values until communication is restored.

The network parameters of a PNS (IP Address, subnet mask, and gateway) should be configured so that each device on the network has a unique IP Address. The I/O Controller will configure the network parameters for the PNS during the Connect sequence.

When the network parameters are set with the DCP tool, they will be maintained over a power-cycle while no IO Controller is connected. If an I/O Controller is connected and the network parameters configured for the PNS do not match the currently retentive parameters stored on the device (those set using a DCP Tool), then the I/O Controller will assign the configured network parameters to the PNS for immediate use during the connection process. This will overwrite the retentive values that were set by DCP with the factory default values for IP, subnet, and gateway, (0.0.0.0/0.0.0.0/0.0.0.0). Note that if the PNS is now power-cycled without an I/O Controller connected, the module will power up with the default network settings because network settings configured by the I/O Controller are not retentive. In order to maintain settings over a power-cycle without an I/O Controller connected, the network settings assigned by the I/O Controller must match the network settings configured with the DCP Tool.

The rate of data exchange is usually configured on the PNS in configuration tools. The PNS supports update rates from 1ms to 512 ms. The correct setting for each device can depend on the dynamics of the equipment being controlled, the network loading on the PROFINET-I/O LAN, and the loading of the I/O Controller. It is possible to have better performance at 2 ms, 4 ms or greater periods than at 1 ms depending on the overall system requirements, design, and loading. The duration of data indicating very brief states or conditions should be taken into consideration in choosing the correct setting.

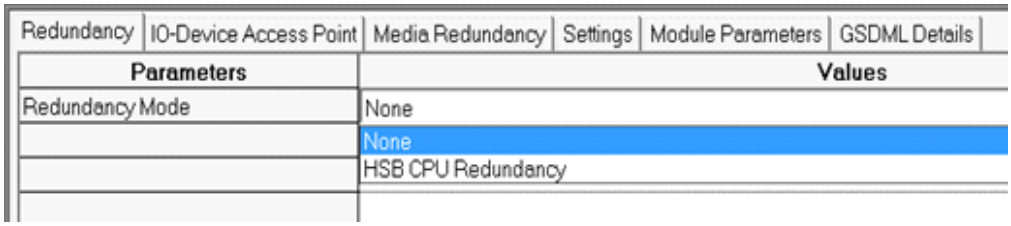
4.2.1.1 Media Redundancy Parameters

By default, the PROFINET Scanner is not set up for Media Redundancy. If the PROFINET Scanner will be a Media Redundancy Client, select the module ports that will be used for Ring Port 1, Ring Port 2 and the MRP Domain. The MRP Domain name is used to assign MRP Clients to the media redundancy manager (MRM) for the network ring. The Domain Name is defined in the PROFINET IO Controller's Media Redundancy tab.

4.2.1.2 System Redundancy Parameters

Refer to GFK-2308G or later for detailed information on setting up a Hot Standby Redundancy system.

The Redundancy tab selects whether or not the PNS is redundantly controlled.



When the PNS supports PROFINET System Redundancy and is configured in an HSB CPU Redundancy system, the Programmer defaults the Redundancy Mode parameter to HSB CPU Redundancy.

When the PNS does not support PROFINET System Redundancy or is not configured in an HSB CPU Redundancy system, the PNS Programmer defaults the Redundancy Mode parameter to None, selecting simplex operation.

To configure a redundancy-capable PNS for simplex operation within an HSB CPU Redundancy system, change the Redundancy Mode parameter from HSB CPU Redundancy to None.

4.2.1.3 Transfer List

All redundantly controlled I/O must be included in the CPU's I/O transfer list. Note that once the HSB CPU Redundancy Mode is set, Proficy Machine Edition automatically expands the Primary CPU's input transfer list to include all of your redundantly controlled PROFINET inputs as you assign reference addresses. Proficy Machine Edition also automatically expands the Primary CPU's output transfer list to include your redundantly controlled PROFINET outputs.

The configuration should be stored to both the Primary and Secondary racks before attempting to control any I/O in the RX3i PNS.

4.2.1.4 Changing a Redundant PNS Configuration

To make changes to the PNS configuration once the system is running, refer to GFK-2308, and follow the procedure Download a Modified Configuration to a Redundancy System – Stopping the Process.

Changes to the device's configuration on either the Primary while the Secondary is running or the Secondary while the Primary is running will cause a *Loss of Device* I/O fault on the controller that is being updated. The controller with the changed configuration will be prevented from re-connecting as long as a non-matching connection exists with the device from any controller.

4.2.2 Adding RX3i Modules

For a list of modules, power supplies and backplanes that can be used with an RX3i PROFINET Scanner I/O Device, refer to the important product information document provided with the firmware version on your PNS module.

4.2.2.1 Adding a Power Supply

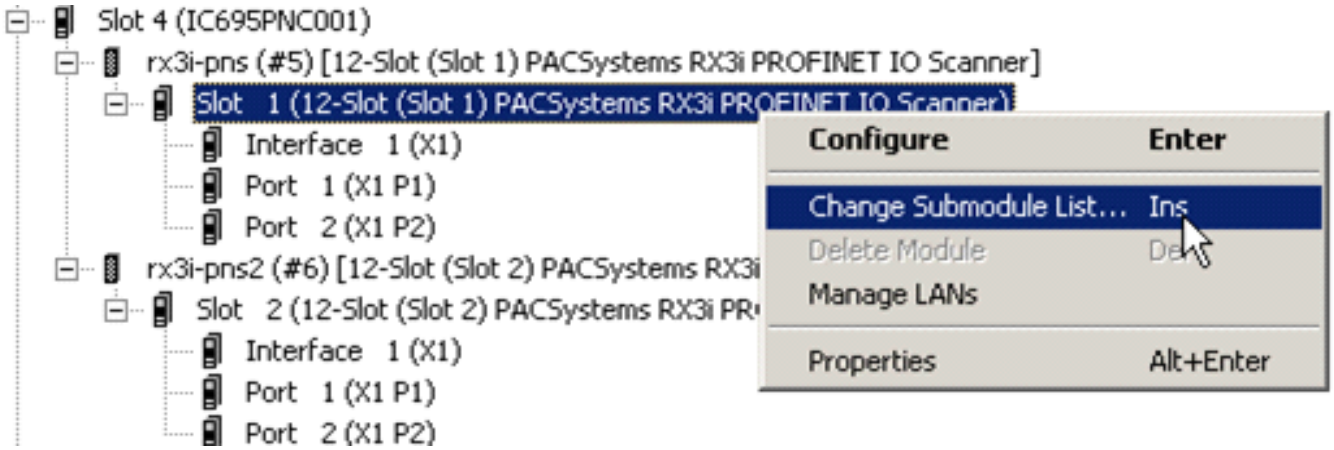
Some power supplies occupy two slots in the backplane. When adding a two-slot power supply to an RX3i Scanner configuration, it should be configured in the left-most slot occupied by the module, and nothing configured for the other slot. For example, when installing an IC695PSA140 power supply in slots 0 and 1 in the backplane, it is configured in slot 0 and nothing is configured in slot 1. Because both slots of a two-slot power supply must fit within the rack, a two slot power supply cannot be placed in the last non-expansion slot of a rack.

Adding power supplies to the configuration sets up power supply alarms. Loss of Module alarms will be triggered if the power supply is configured but not working, or configured in the wrong subslot. These power supplies have no configurable parameters, but their power supply and GSDML details can be viewed by double-clicking on a power supply or right-clicking and selecting Configure.

4.2.2.2 Adding and Configuring an Ethernet Port

SFP modules can be added to the RX3i PNS by selecting the correct SFP module type from the available SFP module list and assigning it to Port 3 or Port 4. See the SFP Modules for Ethernet Ports in Installation chapter for more details about SFPs.

- **To add an SFP module to a PNS:** from the **Proficy Machine Edition,** right-click the **Slot** containing the PNS and select **Change Submodule List** to display a dialog box that presents a list of supported SFP modules.


Slot 4 (IC695PNC001)
rx3i-pns (#5) [12-Slot (Slot 1) PACSystems RX3i PROFINET IO Scanner]
Slot 1 (12-Slot (Slot 1) PACSystems RX3i PROFINET IO Scanner)
Interface 1 (X1)
Port 1 (X1 P1)
Port 2 (X1 P2)
rx3i-pns2 (#6) [12-Slot (Slot 2) PACSystems RX3i
Slot 2 (12-Slot (Slot 2) PACSystems RX3i PR
Interface 1 (X1)
Port 1 (X1 P1)
Port 2 (X1 P2)
Configure Enter
Change Submodule List... Ins
Delete Module
Manage LANs
Properties Alt+Enter

The RX3i Scanner supports setting a port to Automatic (Auto-negotiation enabled), a fixed speed, or Disabled. Automatic enables auto-negotiation for the widest range of options supported by the port. Particular speed options limit the auto-negotiation to that one setting such as limiting a 1 Gbps connection to 100 mbps. The Disabled setting powers down the port so that it does not establish any link. All ports, including empty, unconfigured SFP cages, are set for Automatic by default.

The RX3i Scanner rejects configurations that disable all present ports. This rejection causes the Scanner to fail to establish a connection. For example, if no SFP modules are present and a configuration is attempted which disables the two built-in RJ-45 ports, that configuration does not connect. A configuration which disables the two built-in RJ-45 ports, but has an SFP module configured which is not present also does not connect. In this example, once an SFP module is present in the specified port, the configuration becomes valid and a connection can be established.

Caution

The port delivering the configuration can be disabled by a new configuration and that setting stored to nonvolatile storage. Be sure to understand the network topology before disabling Ethernet ports.

Caution

Port disable settings are nonvolatile. If an SFP port is configured as the only enabled port and that SFP is removed, the RX3i Scanner will not be accessible until an SFP is returned to that port.

4.2.2.3 Configuring Modules with Submodules

Some PACSystems RX3i I/O Modules have configurable functionality that must be configured prior to operation. Proficy Machine Edition indicates an error on the module until its configuration has been completed.

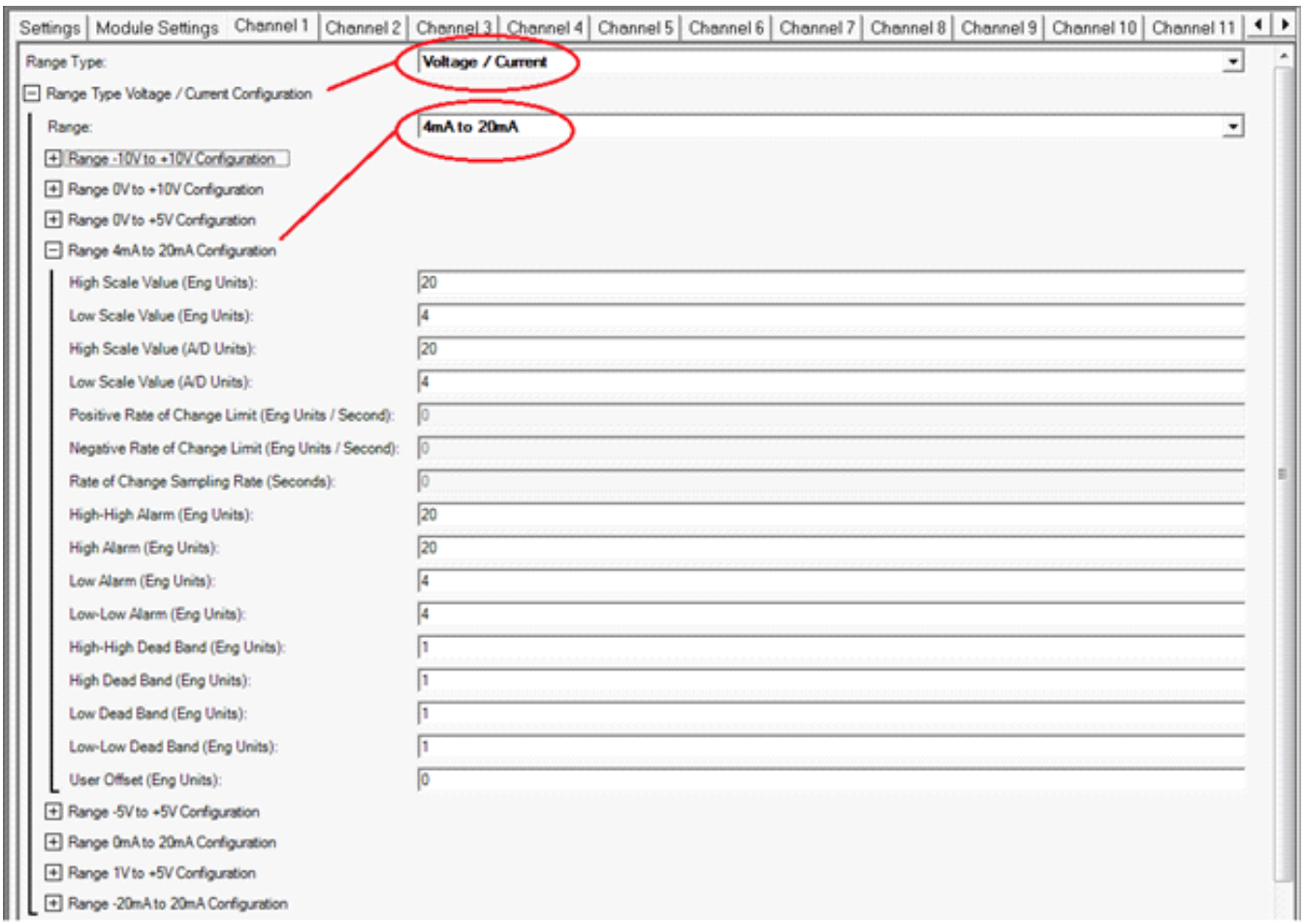
Hardware Configuration *
Rack 0 (IC695CHS012) *
Slot 0 (IC695PSA040)
Slot 1 (Used With Slot 0)
Slot 2 (IC695CPU320)
Slot 3 (Used With Slot 2)
Slot 4 (IC695PNC001) *
rx3i-pns (#5) [12-Slot (Slot 1) PACSystems RX3i PROFINET IO Scanner] *
Slot 1 (12-Slot (Slot 1) PACSystems RX3i PROFINET IO Scanner)
Interface 1 (X1)
Port 1 (X1 P1)
Port 2 (X1 P2)
Slot 2 (IC694ALG442: 4 Input/2 Output Channel Mixed Analog Current/Voltage) * - Please add a submodule using the right-click menu.

To complete the configuration, right click the slot containing the IO Module and select Change Submodule List. This opens a dialog box that presents a list of submodule options.

4.2.2.4 Configuring Modules with Multiple Modes of Operation

Some PACSystems RX3i modules have multiple modes of operation that change the appropriate limits for their configuration parameters. For example, an IC695ALG616 analog input module supports a different set of A/D Scaling Units when in 4 to 20 mA operation than when it is in -10 V to +10 V operation.

These different configuration options are implemented as groups of controls which are activated by a choice made outside of the group and marked with +/- expander controls. Typically, this choice is directly preceding the first group.


Settings
Module Settings
Channel 1
Channel 2
Channel 3
Channel 4
Channel 5
Channel 6
Channel 7
Channel 8
Channel 9
Channel 10
Channel 11
Range Type:
Voltage / Current
Range Type Voltage / Current Configuration
Range:
4mA to 20mA
Range -10V to +10V Configuration
Range 0V to +10V Configuration
Range 0V to +5V Configuration
Range 4mA to 20mA Configuration
High Scale Value (Eng Units): 20
Low Scale Value (Eng Units): 4
High Scale Value (A/D Units): 20
Low Scale Value (A/D Units): 4
Positive Rate of Change Limit (Eng Units / Second): 0
Negative Rate of Change Limit (Eng Units / Second): 0
Rate of Change Sampling Rate (Seconds): 0
High-High Alarm (Eng Units): 20
High Alarm (Eng Units): 20
Low Alarm (Eng Units): 4
Low-Low Alarm (Eng Units): 4
High-High Dead Band (Eng Units): 1
High Dead Band (Eng Units): 1
Low Dead Band (Eng Units): 1
Low-Low Dead Band (Eng Units): 1
User Offset (Eng Units): 0
Range -5V to +5V Configuration
Range 0mA to 20mA Configuration
Range 1V to +5V Configuration
Range -20mA to 20mA Configuration

If multiple options are available, only the controls associated with the active choice are used. The other settings are maintained, but are ignored by the module. To prevent confusion, it is recommended that only the active choice be expanded. The state of the expander control does not affect the choice of active controls. If the active setting is collapsed and not visible, it is still active and its values are used for the module configuration.

4.2.2.5 Configuring Discrete Modules that Have DIP Switches

Some PACSystems RX3i discrete output modules have a physical DIP switch that controls their output's operation when connection to an IO-Controller is lost. A switch selects between Force Off and Hold Last State. This setting applies to all the module's outputs.

The module's documentation lists any additional requirements for Hold Last State to operate correctly. For some modules, field power must be maintained on the PACSystems backplane in order for Hold Last State to operate correctly.

If a discrete output or discrete mixed module does not have a switch or an additional configuration option specifying its output's default action, the hardware default is to Force outputs off.

4.2.2.6 Configuring Modules that have Jumpers

Some PACSystems RX3i analog modules have jumpers on their terminal strips that control the operation of their I/O. For example, the IC69xALG220 can operate as a +10 vdc to -10 vdc analog input or a 4-20 mA analog input depending on a jumper. The IC69xALG390 uses a jumper rather than a DIP switch to control Force Off or Hold Last State operation.

Jumper settings are latched when the module is started, so the jumper setting cannot be altered during operation. The RX3i PNS rack must be power-cycled for the new jumper setting to be reevaluated or the module must be hot-inserted.

4.2.3 Configuring Module Parameters

After adding PACSystems RX3i modules to the remote IO-Device, their parameters must be configured. For all PACSystems RX3i modules, this includes configuring a set of basic parameters such as reference address. Configuration details for those basic parameters are given on the following pages. If the module has no module-specific parameters, a blank grouping of Module Parameters may be displayed in the Configuration Tool.

The RX3i modules listed in the following table require additional configuration beyond the basic parameters described in this chapter. Refer to *GFK–0898, Series 90-30 PLC IO Module Specification*; *GFK-2314, PACSystems RX3i System Manual,*; or the individual module datasheet for detailed parameter information.

Catalog #	Module Description	Datasheet
IC693ALG222	Analog Voltage Input Module – 16 Channel	GFK-2654
IC693ALG223	Analog Current Input Module – 16 Channel	GFK-2655
IC693ALG392	Analog Current/Voltage Output Module – 8 Channel	GFK-2557
IC693ALG442	Analog Module, 4 Inputs / 2 Outputs Current/Voltage	GFK-2687
IC694ALG222	Analog Voltage Input Module – 16 Channel	GFK-2654
IC694ALG223	Analog Current Input Module – 16 Channel	GFK-2655
IC694ALG392	Analog Current/Voltage Output Module – 8 Channel	GFK-2557
IC694ALG442	Analog Module, 4 Inputs / 2 Outputs Current/Voltage	GFK-2687
IC694PSM001	Power Sync and Measurement Module	GFK-2748
IC695ALG112	Isolated Analog Current/Voltage Input Module – 12 Channel	GFK-2482
IC695ALG508	Analog Isolated RTD Input Module – 8 Channel	GFK-2501
IC695ALG600	Universal Analog Input Module – 8 Channel	GFK-2348
IC695ALG616	Analog Current/Voltage Input Module – 16 Channel	GFK-2372
IC695ALG626	Analog Current/Voltage Input Module – 16 Channel with HART[1]	GFK-2372
IC695MDL664	Digital Input Module with Diagnostics – 16-Channel	GFK-2590
IC695MDL765	Digital Output Module with Diagnostics – 16 Channel	GFK-2591
IC695ALG708	Analog Current/Voltage Output Module – 8 Channel	GFK-2373
IC695ALG728	Analog Current/Voltage Output Module – 8 Channel with HART[1]	GFK-2373
IC695ALG808	Isolated Analog Current/Voltage Output Module – 8 Channel	GFK-2481
IC695HSC308	High Speed Counter Module - 8 Counters	GFK-2441
[1] HART communications is not currently supported with the RX3i PNS		

4.2.3.1 RX3i PROFINET Scanner Configuration Validation

Some configuration validation is performed by the RX3i PROFINET Scanner when the configuration is delivered to the scanner. The following table indicates the configuration validations performed for the indicated modules. If the scanner detects an invalid configuration for a given module, the module transitions to module default operation and point faults are energized on the assigned I/O.

If a module listed below receives an invalid configuration, it rejects the configuration, energizes point faults and blinks its OK LED. The module does not transition to an operational state, as indicated by the OK LED being On-Solid, until a valid configuration is stored.

Catalog #	Rules
IC695MDL664	1. Pulse test diagnostic reporting must be disabled when pulse testing is disabled. 2. Open wire and short circuit diagnostic reporting must be disabled when the channel is configured for dual-state input type. 3. Short circuit diagnostic reporting must be disabled when the channel is configured for tri-state input type.
IC695MDL765	1. Pulse test diagnostic reporting must be disabled when pulse testing is disabled. 2. Auto Pulse Normal State and Auto Pulse Default State must not be equal to each other if pulse testing is enabled.
IC695ALG508 IC695ALG600	1. – 5. Same as C695ALG112 6. The Lead Resistance Compensation must be set to disabled for RTD 2-wire operation.
IC695ALG112 IC695ALG616 IC695ALG626	1. The High Scale Value Engineering Units cannot be equal to the Low Scale Value Engineering Units. 2. The High Scale Value A/D Units must be greater than the Low Scale Value A/D Units. 3. The Alarm Limits must be in order, with the High High Alarm greater than or equal to the High Alarm, which is greater than the Low Alarm, which is greater than or equal to the Low Low Alarm. 4. The Alarm Limits must be within the configured Engineering Units plus User Offset range, for example if the High and Low Engineering Unit Scale values are 10,000 and -10,000 and User Offset is 1000, the alarm limit range is +11,000 to -9,000 5. The Alarm Deadbands must be set such that the Alarm can be cleared. For example, if the Engineering Units Scale Range is -5 to 5 and the High Alarm is 4, the High Deadband must be less than 9 or else it is not possible to reach a value that is low enough to clear the High Alarm. Note that the User Offset modifies the range of Alarms and Alarm Deadbands. The User Offset is added to the High and Low Engineering Unit Scale Values to set the alarm range limits.
IC695ALG708 IC695ALG728	1. The High Scale Value Engineering Units cannot be equal to the Low Scale Value Engineering Units. 2. The High Scale Value A/D Units must be greater than the Low Scale Value A/D Units. 3. The High Alarm must be greater than the Low Alarm. 4. The Alarm Limits must be within the configured Engineering Units minus User Offset range, for example if the High and Low Engineering Unit Scale values are 10,000 and -10,000 and User Offset is 1000, the alarm limit range is +9,000 to -11,000. 5. The valid range of Clamp Limits (if enabled) and Default Value is extended slightly beyond the alarm limits minus User Offset, depending on the configured Range. 6. Integer Current: +/- 400 Eng Units (0-20mA +400 Eng Units only) Floating Point Current: +/- 0.4 Eng Units (0-20mA +0.4 Eng Units only) Integer Voltage: +/- 500 Eng Units Floating Point Voltage: +/-0.5 Eng Units 7. The minimum (slowest) ramp rate is the higher Engineering Unit Scale Value minus the lower Engineering Unit Scale Value divided by 60,000. Put another way, the minimum ramp rate must be no slower than the full Engineering Units range traversed in 60 seconds.

IC695ALG808	1. -7, Same as IC695ALG708 1. Open Wire Enable Diagnostic reporting is only valid when the module's Range Type is Voltage/Current and the Range is set to a Current Range. 2. Short Circuit Enable Diagnostic reporting is only valid when the module's Range Type is Voltage/Current and the Range is set to a Voltage Range.
IC695HSC308	1. The counter High Range value must be greater than the Low Range Value. 2. If a counter is configured as Continuous within high/low range or One-shot within high/low range, the PreLoad Value must be within the range. 3. If 1ms is selected as the Timebase Units, the Timebase range is 1 to 429496. If Units are 1 uS, the range is 1 to 429496729. If Units are 100 nS, range is 1 to 2147483647. 4. To be used as a counter Setpoint output an External Output must be configured as Setpoint(s) on the Outputs Tab.

4.2.3.2 Basic Module Parameters

The module parameters define how the IO-Controller scans and stores the module's data. The number of address ranges varies by module and submodule. For discrete data, there is a starting address and a length for input data and another starting address and length for output data. Analog data can be listed with each analog value as a separate address and a length of one or as a group with the starting address listed and an overall length value. What is available can depend on the Configuration Tool.

Input Data / Output Data: The address in the I/O Controller's reference memory for the module's data.

For PACSystems CPUs: Discrete Data can be added to %G, %I, %Q, %T, and %M memory areas. Non-Discrete Data can be added to %AI, %AQ, %R, %W, %G, %T, and %M memory areas.

Length: For discrete modules, the length of the input /output data is fixed and cannot be edited.

Other Data: Some modules have other data areas such as Module Status, ESCP Point Status, or Digital Filter settings. Refer to GFK-2314, *PACSystems RX3i System Manual* or the appropriate User's Manual for more details about the data of each I/O Module.

4.3 Assigning I/O Device Names

After the PROFINET Scanner and other I/O Devices on the LAN have been entered into the configuration, the Discovery and Configuration Protocol (DCP) tool must be used to assign a name to each I/O Device. The name of each device on the LAN must match the hardware configuration in the I/O Controller. This step is required before downloading the configuration from the PROFINET IO Controller, or the PROFINET IO Controller will be unable to connect to the devices and deliver the device's configuration.

The DCP tool must be connected directly to the PROFINET IO LAN. The DCP tool allows you to display an identification pattern on an I/O Device. This can be helpful to distinguish devices apart when all are at factory default settings.

The DCP tool supports issuing a reset command to an I/O Device. A reset clears the device name and sets other nonvolatile settings such as IP, subnet, and gateway to the factory defaults. A Reset to Factory DCP command also clears all Ethernet port settings such as port disabling. This defaults all ports to Enabled with Auto-negotiation on.

4.3.1 Transferring the I/O Device Name with an SD Card

To allow replacement hardware to be commissioned without requiring a DCP Tool, the I/O Device Name can be written to an SD Card and then transferred to replacement hardware via the SD Card.

To write the I/O Device Name to an SD Card, the SD Card must be inserted when the DCP Tool assigns an I/O Device Name to the PROFINET Scanner. An assignment of an I/O Device Name using a DCP Tool writes that name to both the SD Card and the non-volatile storage in the PROFINET Scanner. If the card is removed, the PROFINET Scanner maintains its name from its non-volatile storage.

If a PROFINET Scanner is powered up with an SD Card inserted that is programmed with a valid, non-blank I/O Device Name, that PROFINET Scanner will learn the name on the SD Card and update its non-volatile storage with that name. An SD Card without a name (such as a new, un-programmed SD Card) will not affect the PROFINET Scanner at power up. The PROFINET Scanner will power up and use the I/O Device Name settings present in its non-volatile storage.

If an SD Card is present when a DCP Reset to Factory command is issued from the DCP Tool, the I/O Device Name on the SD Card will be erased. The DCP Reset to Factory command is a method to remove an I/O Device Name from an SD Card.

4.4 After the Configuration is Stored to the I/O Controller

For complete instructions, refer to the documentation for the I/O Controller and the PROFINET I/O configuration tool.

After successfully processing and applying its configuration data, the I/O Controller transfers the configuration for remote I/O Devices over the PROFINET network.

An I/O Controller delivers configuration to an I/O Device when it establishes a connection with the I/O Device. If all connections are lost, the I/O Device retains the most recent configuration received since it was last powered up. If a module has not been configured since being powered up, it remains in its hardware default condition. When the connection(s) are re-established and a configuration is sent to the I/O Device, and the configuration of a module has changed, the I/O Device applies the new configuration.

If there are differences between the expected, configured modules and the actual modules present in the PNS rack when a connection is established, the PROFINET Scanner indicates differences back to the I/O Controller. Refer to Chapter 6, *Diagnostics* for more detail.

Notes

5 Operations

This chapter describes:

- Powerup
- I/O Scanning
- Hot Swap of I/O Modules
- Firmware Updates

5.1 Powerup

When power is applied to the PNS module, it loads a firmware image. During the powerup process, the module runs diagnostics and initializes its hardware components.

After completing powerup sequence, the OK LED changes from being off to solid on green. If a fatal error occurs during powerup, the amber OK LED blinks a unique pattern indicating the nature of the failure.

If the module encounters a hardware failure, invalid firmware image, or the powerup diagnostics fail, the module will not become operational or may enter firmware update mode. Cycling power to the module may restore operation. See Fatal Error Handling in the Diagnostics chapter for more details.

Nonvolatile settings such as the PROFINET Device Name, Ethernet network configuration, and Ethernet Port disable settings are activated before a PROFINET connection is allowed.

5.2 I/O Scanning

5.2.1 PROFINET Scanner Status and Control Data

The RX3i PNS provides 32 bits of input status data and receives 32 bits of output control data. The application program in the I/O Controller system can monitor the input status bits for the PNS module. The output control bits are reserved for future use and have no function at this time.

5.2.1.1 Output Control Bits

The PNS module's 32 bits of control output are reserved for future use.

5.2.1.2 Input Status Bits

The PNS module's 32 bits of input status provide information about the scanner. All status bits are active high

Status Bits	Name	Description
1	Module OK	Indicates the health of the module. A value of 0 indicates the module is powering up or has failed. A value of 1 indicates the module is functioning properly.
2	Reserved	Set to 0
3	Port1 Link Up	1 = port is connected to another device and is communicating. 0 = port is not connected to another device, or the port has some sort of error preventing communications.
4	Port2 Link Up	
5	Port3 Link Up	
6	Port4 Link Up	
7–10	Reserved	Set to 0
11	MRP Enabled	Indicates whether MRP has been enabled or not. A value of 0 indicates that MRP is not enabled. A value of 1 indicates that MRP is enabled.
12	MRP Role	Indicates the MRP role the PNS is operating as when MRP is enabled. A value of 0 indicates that the PNS is currently an MRP Client. A value of 1 indicates that the PNS is currently an MRP Manager, however the PNS does not currently support MRP Manager configuration. If MRP is not enabled, then this bit will be set to zero.
13–32	Reserved	Set to 0

5.2.2 Data Coherency

The RX3i PNS provides coherency at a submodule basis only. This means that output data from a single I/O Controller for multiple modules in the PNS rack might not be applied by the PNS during the same output scan. Likewise, input data from all modules read in a single PNS input scan may not be produced by the PNS during the same PROFINET I/O cycle.

5.2.3 Sampling Rate

The PROFINET Device Update Rate should be taken into consideration with regard to I/O devices in a Scanner rack. I/O data that changes quickly, such as status bits that represent an event in a module and are only set for one scan of the module, may be missed if the update period spans multiple scans of the module. In some cases, other functionality may be utilized to capture momentary events. For example, High-speed Counter Over Range, Under Range, Overflow, and Underflow status conditions can be latched by configuring an unused counter to mirror the operating counter and assigning the event condition as a strobe source. The corresponding strobe status and acknowledge bits may be used to monitor and acknowledge the condition.

5.2.4 Differences From Main Rack (CPU)

Some CPU operations are not supported or exhibit different behavior than when used with I/O modules in a CPU rack.

5.2.4.1 Interrupts

Interrupts are not supported for I/O modules in a PNS rack. Service Requests that disable, enable, suspend, or resume interrupts have no effect. Interrupt driven Logic blocks cannot be used with I/O modules in a PNS rack, and interrupt status bits should be ignored.

5.2.4.2 Do I/O and Suspend I/O

Do I/O and Suspend I/O operations are limited to updating or suspending the data between the CPU and PNC. The PROFINET I/O scan is not altered (that is, DO_IO data is not exchanged with the PNS any faster than the PROFINET update rate allows).

5.2.5 Output Control

If an output module has not been configured since being powered up, it remains in its hardware default condition. If an output module has been configured, the configuration will specify the output action when communication with the I/O Controller is lost. This is typically one of the following:

- force to the zero state
- default to a specified value, or
- hold the last given value.

5.2.5.1 Simplex Connections

For simplex PROFINET connections (one I/O Controller connection to the RX3i PNS), communications with the I/O Controller are lost when no message has been received from the I/O Controller in a number of I/O Update periods (typically three).

5.2.5.2 Redundancy Connections

For PROFINET system redundancy connections, the configured output action is applied immediately when the controlling Primary connection is lost and no matching Backup connection is established. A Primary connection is lost if no message is received from the Primary I/O Controller within a number of I/O Update periods. This is similar to simplex operation because outputs are only controlled only over a Primary connection in PROFINET system redundancy.

If the Primary connection is lost in PROFINET system redundancy but a matching Backup connection exists, outputs are held at their last given value for a period of time to allow the Backup connection to be switched into the Primary role. The period allowed is calculated by the configuration tool. (Proficy Machine Edition uses the CPU sweep rate, I/O Update Rate, network loading, and values from the GSDML to generate this value). If the Backup connection does not switch to Primary within this period, the RX3i PNS terminates the connection and follows the rules for when no connections exist. If the Backup connection is lost during this period, outputs immediately follow the rules for when no connections exist.

5.3 Hot Swap of I/O Modules

If a module is hot extracted (removed with power applied to the system), the PNS detects the removal and generates a *PROFINET Pull Alarm*. When the PNS is connected to a PACSystems I/O Controller, the Pull Alarm is reported as a *Loss of I/O Module* fault and all point faults for the missing module have the Fault Contact on.

When a module is hot inserted, the PNS detects the insertion and determines whether the configuration expects the module to be present or not.

- If the module is not present in the configuration, no alarm or fault is generated. The module remains idle at its default state.
- If a module is inserted while the PNS has an established PROFINET connection and the module does not match the configured module, including any hardware setting such as a DIP Switch position, a *PROFINET Plug Wrong Submodule* alarm is generated. This appears as a *System Configuration Mismatch* PLC Fault in RX3i systems. Fault Contacts for the module remain in the Fault (on) state.
- If a module is inserted while the PNS has an established PROFINET connection and the module matches the configured module, a *PROFINET Plug Alarm* is generated. This appears as an *Addition of I/O Module* I/O Fault in RX3i systems. The module is configured using the established PROFINET connection and once the I/O module is ready, I/O will start scanning and point fault contacts will transition to reflect any change in the state of the I/O.

Operation must continue to obey PACSystems Hot Insertion and Removal requirements as documented in GFK-2314, *PACSystems RX3i System*. This mostly governs the timing requirements for physically seating a module.

Note The PNS module should not be installed or removed while power is applied to the system. System power must be removed before installing or removing the module.

5.4 Firmware Updates

Note The RX3i PNS does not prevent initiation of firmware update when it is actively connected to an I/O Controller. When the PNS enters firmware update mode, the PNS and its modules go to their I/O default modes. During the update, the PNS does not drive module outputs or send inputs to the I/O Controller. When the firmware update is completed and the PNS is rebooted, its previous connections are re-established and control resumes.

Refer to chapter 2, the section, Powerup LED Patterns.

The PNS enters firmware update mode when commanded to do so from the Winloader update utility, or if a firmware component is corrupted or invalid. In firmware update mode, the PNS module blinks its LEDs in a special pattern as described previously, and its Ethernet ports are not operational.

If the PNS has experienced a fatal error, the module goes to an LED blink-code error condition and does not communicate with Winloader, causing Winloader to return a timeout failure indication. The module must be power-cycled before reattempting the update.

5.5 Installing the USB Port Driver

The USB port is only used for firmware updates. USB driver files are provided as part of upgrade packages compatible with the PNS.

With the provided installation files accessible on either a local or network drive, connect the computer's USB port to the PNS module's USB port. When requested, direct the installation to the proper location of the installation files.

The serial port name is COM followed by the next available number from 1 to 256. After the computer assigns the USB port a COM port number, that computer uses the same COM port number each time it connects to that PNS module.

Note When connecting the USB cable to the PNS, you may receive a warning for installing a driver that has not passed Windows Logo testing. This warning should be ignored. Because each PNS has a different serial number, the operating system recognizes each driver installation as different.

Notes

6 Diagnostics

This chapter describes:

- Configuration Faults
- Version Information
- Fatal Error Handling
- Connection Troubleshooting

6.1 Configuration Faults

If there are differences between the expected, configured modules and the actual modules present in the PNS rack, in the expected slots, when a connection is established, the PROFINET Scanner indicates differences back to the I/O Controller.

- If a module is configured, but is not present or operational in the rack, the PROFINET Scanner indicates there is no module. When used with a PACSystems PROFINET I/O Controller, a *Loss of Module* fault is reported and all point faults for the missing module have the Fault Contact on.
- If a module is configured but does not match the module present, the PNS reports the module is wrong. When used with a PACSystems PROFINET I/O Controller, a *System Configuration Mismatch* fault is reported and all point faults for the module have the Fault Contact on.
- If the module configured is correct, but the module has submodule options that relate to a DIP Switch setting on the hardware and the DIP Switch does not match the configuration, the PNS reports the module is wrong. When used with a PACSystems PROFINET I/O Controller, a *System Configuration Mismatch* fault is reported and all point faults for the module have the Fault Contact on.
- If the actual module correctly matches the configured module, but the configuration for the module is unacceptable, the module rejects the configuration and energizes point faults until the configuration is corrected. Many modules blink their OK LED when they reject the configuration. Chapter 4, the section *RX3i PROFINET Scanner Configuration Validation* specifies the rules different modules use to validate their configuration.
- If an SFP module is configured but an incorrect, supported SFP is present, the PNS will allow the present SFP to become operational and issue a substitution alarm. The SFP module operates fully as if no difference was detected. When used with a PACSystems PROFINET I/O Controller, a *Valid Module Substitution* fault is reported.
- If a module is installed but not included in the configuration, no problem is reported. The module is ignored by the PROFINET Scanner and defaults itself.
- If an SFP is installed but not included in the configuration, default operation is enabled and active.

6.2 Version Information

The RX3i PROFINET Scanner supports the standard PROFINET Identification and Maintenance (I&M) functions. I&M0 Revision information is returned for the PNS slot with the information for the PROFINET Scanner.

Please consult the documentation for your IO-Controller and configuration tool for how to access I&M data. For PACSystems PROFINET I/O Controllers, this is available under the Explore PROFINET Networks option in Proficy Machine Edition (for details, refer to this topic in the applicable PROFINET Controller user's manual).

6.3 Fatal Error Handling

Any failures that occur during powerup or firmware update mode are considered fatal errors. This includes faults detected on non-critical devices such as the USB port. After successful powerup of the PROFINET Scanner, only catastrophic errors are treated as fatal. When a fatal error occurs, the PROFINET scanner blinks an error code on its LEDs (refer to the chapter *LED Operation and Connector Details* the section,*Fatal Error Codes*.

Certain conditions can prevent the module from powering up and becoming operational or entering firmware update mode:

Problem	Indication	Action
Hardware failure	• All LEDs off and the module is unresponsive, or • The STATUS LED is solid Green and is the only LED that is on.	Return the module to GE Intelligent Platforms
Invalid firmware		
Power-up diagnostics/hard-ware initializations fail that are considered fatal	LED Fatal Error blink code	Note the blink code and contact Customer Service
Catastrophic error during operation	LED Fatal Error blink code	Note the blink code and contact Customer Service

6.4 Connection Troubleshooting

A PROFINET I/O Device can be challenging to troubleshoot if a connection to the I/O Controller will not establish. Below are some suggestions of possible things to consider:

- Verify the network cabling. Scan the network using both the DCP and Explore PROFINET Networks tools in Proficy Machine Edition. The I/O Controller and I/O devices should appear in both tools.
- Verify the spelling of an I/O Device name in the DCP return value from the I/O Device versus the I/O Device name in the I/O Controller configuration. Verify the I/O Controller configuration matches the configuration active in the I/O Controller.
- Simplify the configuration. Extra, unconfigured modules are generally not an error in PROFINET, so a simpler configuration could connect.
- Invalid configurations could be rejected. For example, disabling all Ethernet ports would lead to significant problems, so the connection with such a configuration is rejected outright. Simplifying the configuration back to defaults can help isolate problem areas and settings.
- PROFINET configuration occurs using the Ethernet IP settings. If an I/O Device cannot be PINGed from the I/O Controller's network location, the problems are more likely in the network or the I/O Device's DCP settings (i.e. the device has an incorrect name or no IP address) than the I/O Device configuration.
- Verify the MRP Ring ports selected. If MRP is configured to use Ethernet ports that are not available, then the connection will fail. This may be an MRP Ring port configured for a removable port (SFP) that is not present, or an MRP Ring port configured for a removable port (SFP) that is malfunctioning. Disabling MRP Client during debugging may help identify SFP problems.

Appendix A PROFINET Specifications

Release 2.00 of the RX3i PROFINET I/O Scanner supports PROFINET v2.3 Class A I/O Device with the clarifications listed below. For version-specific updates, refer to the Important Product Information document provided with your module.

PROFINET Protocol Support

RTC – Real time Cyclic Protocol: RT_CLASS_1
DCP – Discovery and Configuration Protocol
CL-RPC – Connectionless Remote Procedure Call
LLDP – Link Layer Discovery Protocol – transmission only
MRP – Media Redundancy Protocol – Client only

Technical Data

API:	Single API (0) used.
Number of Application Relations supported:	2 (1 backup and 1 primary forming a redundant-AR set or 1 simplex)
Maximum length of cyclic input data:	1440 bytes
Maximum length of output data:	1440 bytes
Alarm Types:	Pull, Plug, PlugWrong
DCP:	Get/Set/Identify supported. Only All and Name Of Station filters supported
Identification & Maintenance:	I&M Data (I&M0 only)
Context Management:	by CL-RPC
Minimum cycle time:	1 ms
Ethernet rate:	100/1000 Mbit/s full duplex with auto-negotiation

Limitations

The following features are not supported in release 2.20.

PACSystems Features

Alarms
Command Feedback data
CommReq commands to I/O Modules
Alarms on Hot Swap of SFP modules
Firmware update of I/O Modules
Interrupts from I/O Modules
Version information on I/O Modules

PROFINET Features

Autoconfiguration
Configure In Run
DCP Hello service
DHCP
Diagnostic Alarms
DNS (Domain Name Service protocol)
FastStartUp
IRT (Isochronous Real Time Protocol)
Multicast communication
PROFIenergy Profile
PROFIsafe Profile
PROFINET CBA
PTCP (Precision Transparent Clock Protocol)
RT over UDP
Shared I/O device
SNMP (Simple Network Management Protocol)
Substitute Data
Supervisor-AR

Only one Input-CR and one Output-CR are supported per AR.

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